Valuing Nonfatal Cancer Risks in Cost-Benefit Analyses

Public Meeting
October 29, 2020

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Purpose

Present approaches to value nonfatal cancer risks for use in cost-benefit analyses

Logistics and Ground Rules

Category 3 Public Meeting

Questions and discussion are encouraged

Please identify yourself and the organization you represent (if any) before speaking

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Agenda

- Background
- Approaches to Health Risks Valuation
- Federal Agency Practices
- NRC Proposed Approach for Nonfatal Health Risks
- Next Steps

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Background

NRC conducts regulatory analyses for Commission decisionmaking

Health detriments from radiation exposure are valued using a dollar per person-rem conversion factor

NUREG-1530 provides the dollar per person-rem conversion factor

In the SRM to SECY-12-0110, the Commission approved the staff's plan, which included updating NUREG-1530

Dollar per Person-Rem Conversion Factor

- Dollar per person-rem conversion factor is used in cost-benefit analyses to determine the monetary valuation of the consequences associated with radiological exposure
- Dollar per person-rem is the product of
  - value of a statistical life (VSL)
  - probability for stochastic health effects per radiological dose

dollar per person-rem = value of a statistical life ($) x nominal risk coefficient (per rem)

NUREG-1530, Revision 1

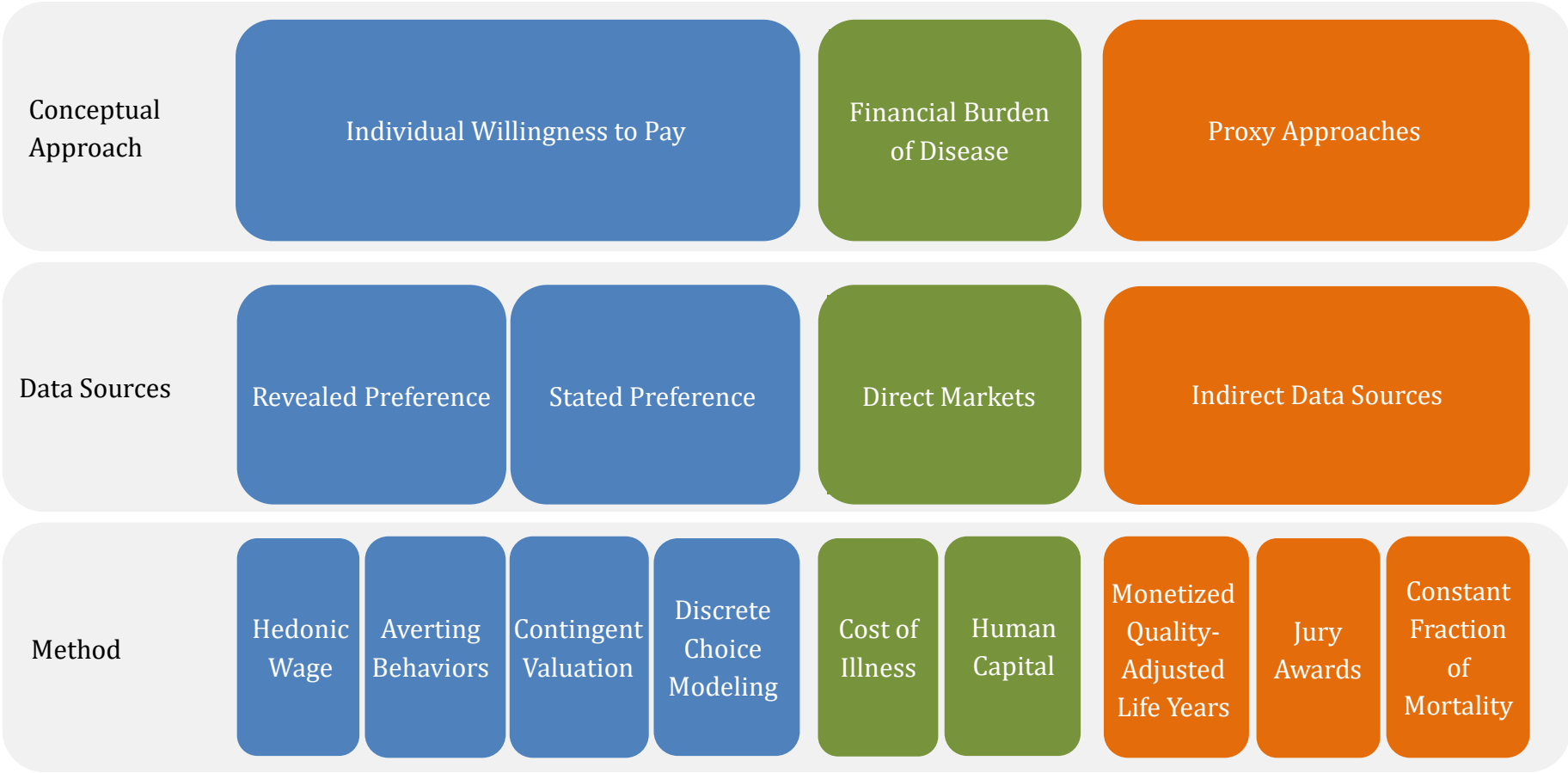
In revising the NUREG, the staff is proposing to change its method for valuing radiological exposure

Incorporates a revised method for valuing cancer mortality

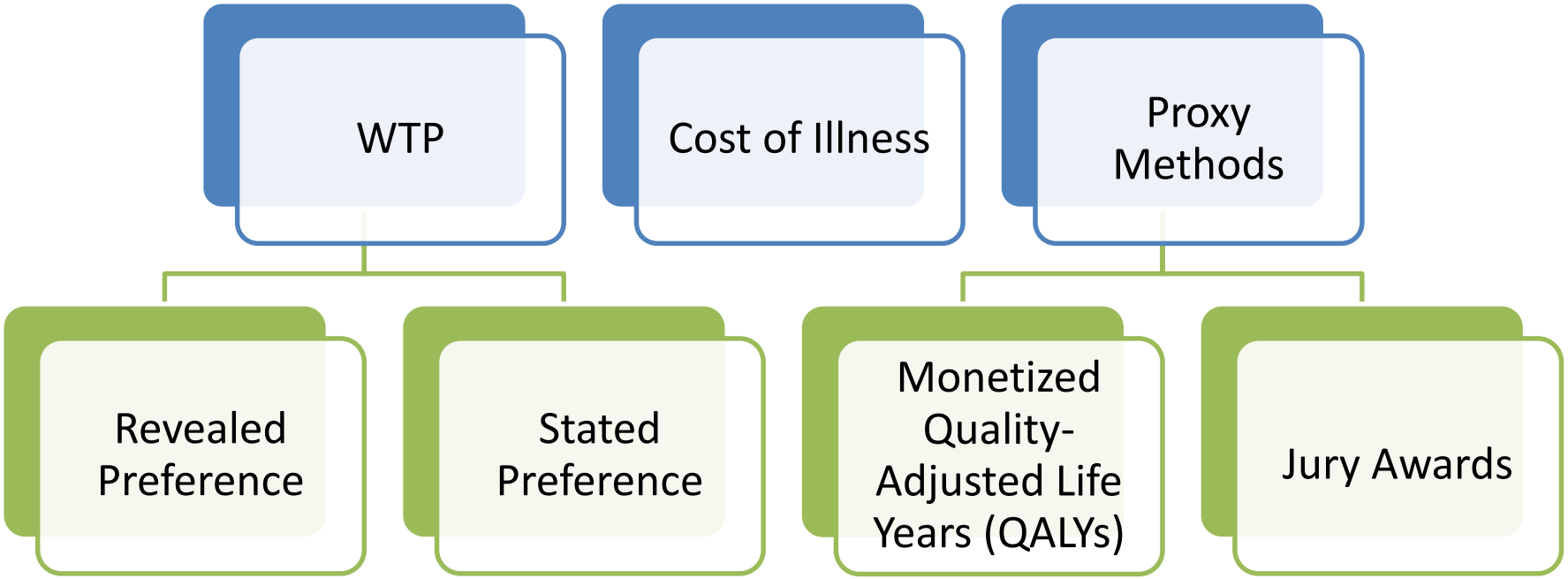
An approach for valuing nonfatal cancer risk is not included

Approaches to Health Risks Valuation

Approaches to Valuation



Approaches to Valuation (cont.)



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OMB Circular A-4, Regulatory Analysis

Willingness to pay (WTP) is the most appropriate measure for monetizing health benefits

Office of Management and Budget (OMB) recommends using alternative approaches (e.g., health utility studies) when WTP data is not available

Willingness to Pay

The rate at which individuals would spend their own money for small changes in their nonfatal cancer risk within a defined time

Revealed Preference

Utilize individual's choices in real markets

- Hedonic wage
- Averting behaviors

Advantages

- Based on market data and observable choices that individuals make

Disadvantages

- Assumes individuals are risk-aware
- Limited data

Stated Preference

Usually involves surveying individuals about the value they place on a good or service in a hypothetical market

Advantages of surveys

- Used to analyze the specific risk of concern
- Provides detailed information about the health risks they are valuing
- May include questions to gauge the understanding of the information

Disadvantages of surveys

- Participants have less incentive to carefully consider their choices
- Subject to biases (e.g. warm glow effect, protest responses)

Cost-of-Illness

Estimates the financial burden of a disease on an individual and society

Cost Components

- Direct costs of medical treatment
- Indirect costs due to lost productivity and lost income
- Indirect opportunity costs such as lost leisure time

Advantages

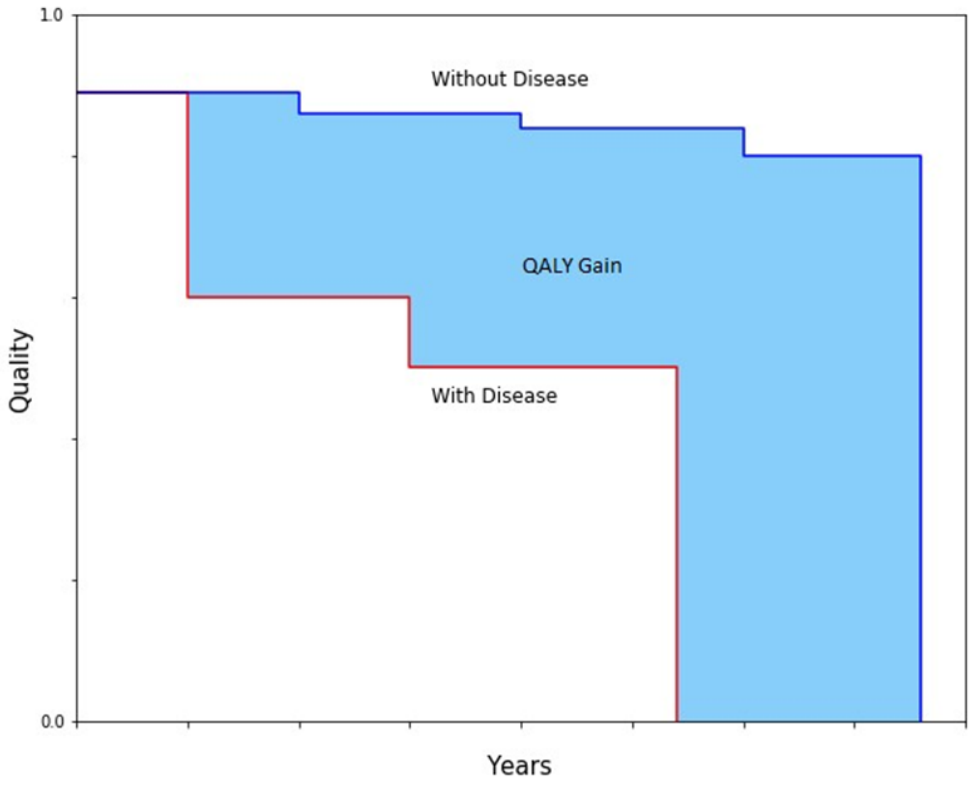
- Cost components based on market data
- Relatively easy to explain and understand

Disadvantages

- Does not capture pain and suffering
- May greatly underestimate WTP

Quality-Adjusted Life Years

- A summary measure of a health outcome including both the years and quality of life
- Used extensively in cost-effectiveness analysis of medical interventions
- Health index
  - 1 = ideal health
  - 0 = death



Quality-Adjusted Life Years (cont.)

QALY monetization is typically done by dividing the VSL by remaining life expectancy

Output is value of statistical life year (VSLY)

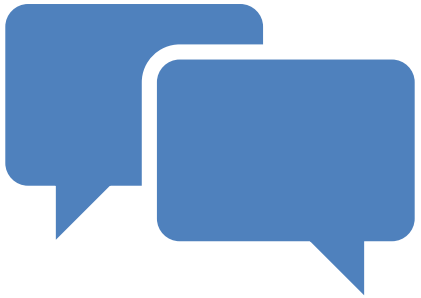
Advantage

- QALY values exist for a vast number of illnesses

Disadvantage

- Methods used to develop QALYs are proxy methods that are not based on direct value elicitations

Open Discussion



Federal Agency Practices

Federal Agency Practices

- NRC reviewed available Federal-wide guidance and rulemakings that valued nonfatal health effects
- Agencies reviewed
  - Environmental Protection Agency (EPA)
  - Department of Health and Human Services (HHS)
  - Food and Drug Administration (FDA)
  - Department of Transportation (DOT)
  - Department of Labor (DOL)
  - Department of Agriculture (USDA)

Environmental Protection Agency

The EPA published "Guidelines for Preparing Economic Analyses," in 2010, providing an overarching framework for economic analyses

Discusses different approaches to health valuation

Benefits transfer of existing WTP values is the preferred approach

Example of the Environmental Protection Agency's Analyses

- "Arsenic in Drinking Water Rule Economic Analysis"(2000)
  - Used benefits transfer of WTP estimate to avoid chronic bronchitis as a surrogate for bladder cancer
  - WTP estimate is based on 1996 study of nonfatal lymphoma risks (Magat et al., 1996)

Health and Human Services Guidelines

- "Guidelines for Regulatory Impact Analysis"
  - WTP is the preferred method
  - Monetized QALYs is a proxy if WTP estimates are unavailable
- The Guidelines provide detailed guidance on the application of monetized QALYs

Food and Drug Administration Recent Analysis

- "Smokeless Tobacco" Proposed Rule used a monetized QALY approach to value changes in oral cancer risks
- Estimated the present discounted value of QALYs gained for an individual 62 years old (median age of diagnosis)
- Assumed for a case of oral cancer:
  - Upon diagnosis, assign a health-related quality of life (HRQL) of 0.68 for first year during treatment
  - Recurrence risk within 5 years of diagnosis is 19.1% with an HRQL of 0.68
  - For cancer patients who remain cancer free for 5 years, the HRQL is 0.75

Food and Drug Administration Recent Analysis (cont.)

- For the baseline case, age-specific HRQL weights are assigned in each year of life between 62 and 100.
- The QALY is monetized by dividing VSL by the present discounted QALYs remaining for an individual 40 years in age and averaged across gender.

Mean HRQL Scores (EQ-5D US)		
Age	Male	Female
20 - 29	0.928	0.913
30 - 39	0.918	0.893
40 - 49	0.887	0.863
50 - 59	0.861	0.837
60 - 69	0.84	0.811
70 - 79	0.802	0.771
80 - 89	0.782	0.724

Scores taken from Hanmer et al 2006.

Department of Labor Examples

- Two recent final rules monetized benefits of decreased cancer risks:
  - Occupational Exposure to Respirable Crystalline Silica
  - Occupational Exposure to Beryllium
- Used the WTP approach and provided low and high estimates for valuation
  - Low value: value of statistical injury derived from an analysis of hedonic wage studies
  - High value: WTP to avoid non-fatal lymphoma as a fraction of VSL
  - Did not designate a “best” estimate

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Department of Agriculture Practice

- Within the USDA, the Economic Research Service publishes and maintains costs of foodborne illnesses for 15 major pathogens
- Cost estimates
  - Medical costs due to inpatient and outpatient care
  - Opportunity costs of lost workdays
- The WTP to avoid pain and suffering associated with nonfatal illness risks is not monetized:
  - Lack of suitable WTP estimates
  - Cited two National Academy of Science committee and EPA Science Advisory Board recommendations against monetizing QALYs

Department of Transportation

- DOT publishes crash injury costs by severity on the Maximum Abbreviated Injury Scale (MAIS)
- DOT establishes relative disutility factors, which represent a fraction of VSL, for non-fatal injury levels

Relative Disutility Factors by Injury Severity

MAIS Level	Severity	Fraction of VSL
MAIS 1	Minor	0.003
MAIS 2	Moderate	0.047
MAIS 3	Serious	0.105
MAIS 4	Severe	0.266
MAIS 5	Critical	0.593
MAIS 6	Unsurvivable	1.000

Conclusion

- The general consensus is that WTP is the best method to value morbidity risks; however, there is limited applicable WTP data
- Two approaches have been recently applied by Federal agencies for valuing cancer morbidity
  - EPA/Occupational Safety and Health Administration–benefits transfer of a WTP estimate
  - HHS (FDA)–monetized QALYs

NRC Proposed Approach for Nonfatal Cancer Risks

Considerations

- The application of WTP estimates is the preferred method for monetizing changes in health risks
- However, in absence of available estimates, OMB allows the use of proxy measures such as health utilities
- The literature review revealed a single reference for nonfatal cancer risks that used the WTP approach to value only one cancer type (lymphoma)

Considerations (cont.)

- Exposure of a population to radiation can induce other types of health effects (e.g., leukemia, multiple myeloma, thyroid cancer, breast cancer, lung cancer)
- Other Federal agencies have successfully applied the QALY approach in the absence of WTP data
- Sufficient data sources are available to address morbidity effects using a monetized QALY approach

Proposed Approach

- Estimate the value per statistical cancer using a monetized QALY approach that makes use of existing HRQL values
- Apply these value estimates to the nonfatal portion of the EPA's cancer incidence risk coefficient

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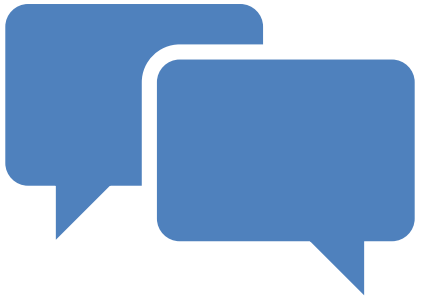
Open Discussion



Next Steps

- Incorporate, as appropriate, feedback from this public meeting
- Develop estimates of nonfatal cancer risk values as an appendix to NUREG/BR-0058, Revision 5
- Issue the appendix for public comment/public meeting
- Consider public comments and finalize the appendix
- Brief the Advisory Committee on Reactor Safeguards on final appendix
- Submit final appendix to Commission for review and approval

How Did We Do?

There are several ways you can provide your feedback on this meeting:

- Scan QR code for NRC Public Meeting Feedback Form- Meeting ID # 20201083

- Go to the Public Meeting Schedule and click on the "Meeting Feedback" link.

Backup Slides

References

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Acronyms

DOL Department of Labor	DOT Department of Transportation	EPA Environmental Protection Agency
FDA Food and Drug Administration	HHS Department of Health and Human Services	HRQL health-related quality of life
MAIS Maximum Abbreviated Injury Scale	NRC Nuclear Regulatory Commission	OMB Office of Management and Budget
QALY quality-adjusted life year	SRM staff requirements memoranda	USDA United States Department of Agriculture
VSL value of a statistical life	VSLY value of a statistical life year	WTP willingness to pay

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Willingness to Pay

- X represents an individual's initial wealth and nonfatal cancer risk (morbidity)
- Rate of tradeoff, represented by the slope of the line, is called the WTP.
- $WTP = \frac{dw}{dp} \sim \frac{\Delta w}{\Delta p}$, for small changes in risk